

PARTICLE SWARM OPTIMIZATION



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WHAT IS THE OPTIMIZATION PROBLEM?

Mathematical optimization is the study of maximizing or minimizing a function subject to constraints, essentially finding the most effective and functional solution to a problem.

Minimize/maximise: $f(x)$

Subjects to constraints:

$$g_i(x) \leq 0, \quad i = 1, 2, \dots, m$$

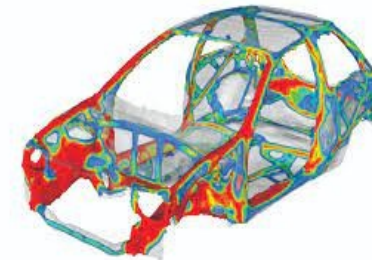
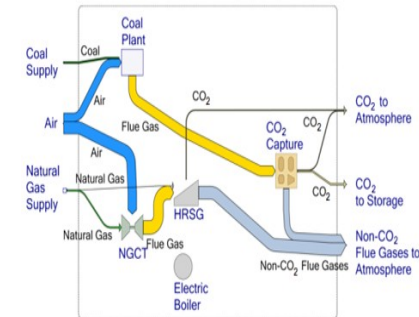
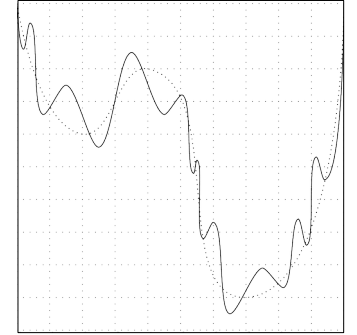
$$h_j(x) = 0, \quad j = 1, 2, \dots, p$$

A faint, light blue background image showing a particle swarm optimization process. It features several small, dark blue spheres (particles) connected by thin, light blue lines, suggesting movement and interaction within a swarm. The overall aesthetic is clean and technical.

PARTICLE SWARM OPTIMIZATION IN GENERAL

DEFINITION AND APPLICATION

- Particle Swarm Optimization (PSO) is a heuristic optimization algorithm inspired by the social behavior of birds and fish. It was introduced by Dr. Eberhart and Dr. Kennedy in 1995. PSO is used to find approximate solutions to optimization and search problems by mimicking the collective movement of a group of particles in a



ALGORITHM

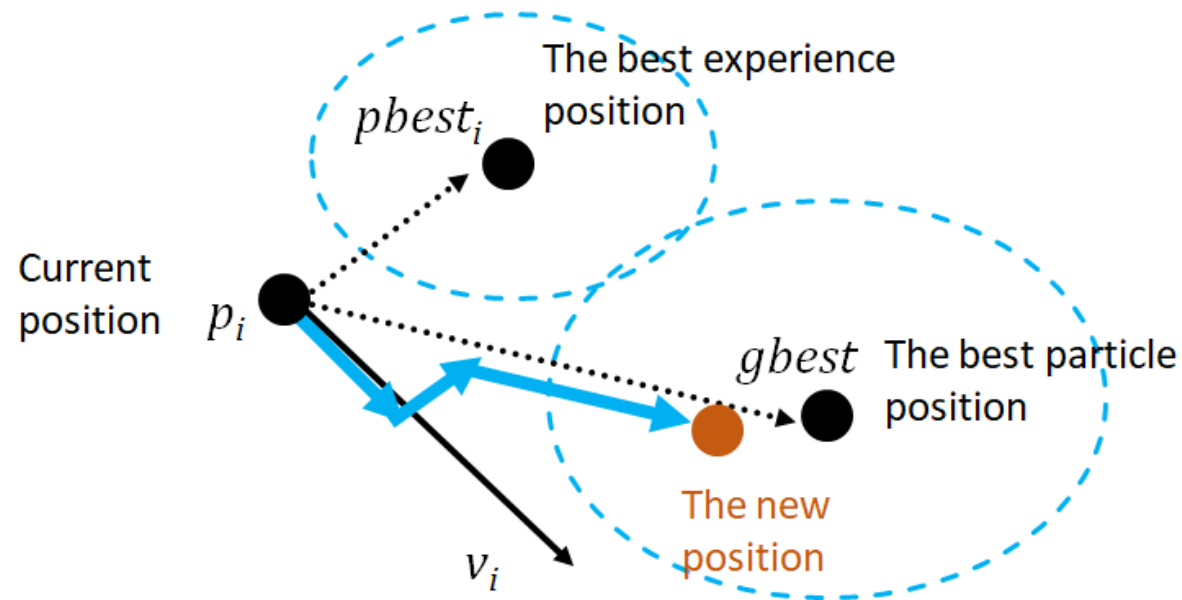
	STEPS
1	particle swarm creation
2	finding the best solution for <i>each</i> particle
3	finding the best solution for <i>all</i> particles
4	correction of the velocity of each particle
5	changing location of each particle
6	() stop condition / repeat



MATHEMATICAL MODELS

$$v_i^{t+1} = \underbrace{v_i^t}_{\text{Inertia}} + \underbrace{c_1 r_1 (pbest_i^t - p_i^t)}_{\text{Personal influence}} + \underbrace{c_2 r_2 (gbest^t - p_i^t)}_{\text{Social influence}}$$

$$p_i^{t+1} = p_i^t + v_i^{t+1}$$



“ALL INVENTOR
FAILS 999 TIMES,
AND IF HE
SUCCEEDS ONCE,
HE’S IN.”



CHARLES KETTERING



INVENTORS OF PSO

DR. JAMES KENNEDY



He is a computer scientist who, along with Dr. Russell Eberhart, co-authored the seminal paper titled "Particle Swarm Optimization" in 1995, which introduced the PSO algorithm. Dr. Kennedy has made significant contributions to the field of optimization and computational

DR. RUSSELL C.
EBERHART



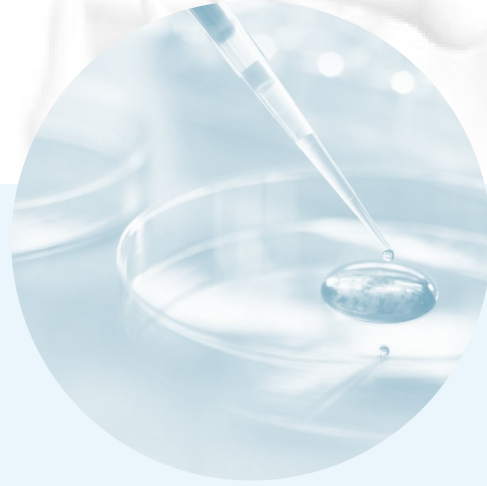
He is a computer scientist and engineer known for his work in optimization, control systems, and swarm intelligence. Dr. Eberhart, along with Dr. James Kennedy, co-developed PSO, which has since become a widely used optimization algorithm in various applications.

SUMMARY

In summary, PSO is an efficient optimization algorithm with a straightforward implementation. Its simplicity and adaptability make it attractive for various applications.

However, PSO may struggle with premature convergence to suboptimal solutions, especially in high-dimensional or complex search spaces. Researchers often explore variations and hybrid approaches to address specific challenges associated with PSO in different optimization scenarios.





THANK YOU!

MATHEMATICAL AND COMPUTER MODELING OF VARIOUS TECHNICAL
AND SCIENTIFIC PROBLEMS